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Results of Field Experiments Crop and Stock Records and other Statistics

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CONTENTS

A. Field Experiments—Ground Crops

1. Rice: Variety trials (Kizimbani).
2. Rice: Mngazija selections (Kizimbani).
3. Rice: Seed rates (Kizimbani).
4. Rice: Level of phosphatic fertilizer (Kizimbani).
5. Rice: Treatment of land between successive crops (Kizimbani).
6. Maize: Plant population and fertility level (Kizimbani).
7. Maize: Plant population and residual fertility (Kizimbani).
8. Maize: Application of nitrogen fertilizer (Kizimbani).
9. Maize: Placement of phosphate fertilizer (Kizimbani).
10. Maize: Variety trial for rust resistance (Makunduchi).
11. Sweet potatoes: NPK and FYM (Kizimbani).
12. Sweet potatoes: Farmyard manure (Kizimbani).
13. Sweet potatoes: Spacing of ridges (Kizimbani).
14. Yams: Fertilizer trial (Makunduchi).
15. Yams: Fertilizers, compost and coir dust (Mkwajuni).
16. Cassava: Variety trials.
17. Pineapples: Mulching (Kizimbani).
18. Derris: Periods to harvest (Kizimbani).
19. Microplot trials with coir dust ash.

B. Field Experiments—Tree Crops

1. Coffee: Fertilizers and mulch (Kizimbani).
2. Cloves: Fruiting hormone (Kizimbani).
3. Limes: Seedlings v. budded plants and fertilizers.

C. Yield Records

1. Cocoa.
2. Citrus.
3. Ylang Ylang
4. Nutmegs.

D. Stock Husbandry

1. Grass introductions.
2. Natural grazing: Manurial trial (Pemba).
3. The milking herd (Kizimbani).

RESULTS OF FIELD EXPERIMENTS, CROP AND STOCK RECORDS AND OTHER STATISTICS

A. FIELD EXPERIMENTS—GROUND CROPS

1. Rice Variety Trials (Kizimbani)

The varieties under test in these trials were three Trinidad varieties and one local variety, Mngazija, which has been proved to be one of the best local varieties for semi-swamp conditions. The trials were conducted at three sites, Kizimbani nursery, Kinuni Moshi and Nguruweni. The nursery site is well supplied with water, Nguruweni is rather dry, and Kinuni Moshi is intermediate. The Nguruweni and Kinuni Moshi sites received a fertilizer dressing of 2 cwt. single super-phosphate and 1 cwt. sulphate of ammonia per acre. The nursery site received 3 cwt. single superphosphate, 1 cwt. sulphate of ammonia and 3 tons farmyard manure per acre.

Design: Randomized blocks.
Results:

Variety	*Yield: lb. paddy per acre*		
	Nursery	*K. Moshi*	*Nguruweni*
Red American	3,040	2,260	1,600
Sughandi	3,025	2,290	1,150
D 52/37	2,175	1,880	1,680
Mngazija	2,015	1,630	1,220
Differences required for significance:			
at P = 0.01	1,233	601	309
at P = 0.05	891	436	220

Red American gave significantly higher yields than Mngazija, at the 1 per cent. point at Kinuni Moshi and Nguruweni and at the 5 per cent. point at Kizimbani nursery. Sughandi showed the same significant increases at Kinuni Moshi and the nursery, but failed at the dry Nguruweni site. D 52/37 gave a significantly higher yield than Mngazija, at the 1 per cent. point, at Nguruweni, but not at the two wetter sites. Red American and Sughandi very closely approached significance over D 52/37 at the wettest site, while Sughandi also did so at Kinuni Moshi.

2. Rice. Mngazija Selections (Kizimbani)

In 1955, selections of individual heads within a plot of Mngazija were made on the basis of weight per head. Bulking and selection continued in 1956 and 1957, and in 1958 a randomized trial including six of the selections was laid down at the nursery site.

Design: 6×6 Latin square.
Results:

Selection	*Yield: lb. paddy per acre*
K22 ..	2708
K28 "C" ..	2575
K21 ..	2508
K17 ..	2158
K16 ..	2133
K14 ..	2067

Difference required for significance (P=0.01) = 742
Difference required for significance (P=0.05) = 543.

Selection K 22 gave significantly higher yields, at the 5 per cent. point, than selections K 17, K 16 and K 14. Selection K 28 "C" approached significance over K 14.

3. Rice. Seed Rates (Kizimbani)

Experiments to determine the optimum seed rate for mechanical drilling began in 1954. They have included trials with and without fertilizers and with fertilizers at different levels. There has, however, been some difficulty in ensuring completely accurate seed rates using a normal field drill on small experimental plots. In the 1958 trial, therefore, a measured quantity of seed was placed by hand in drills 6 inches apart. No significant difference was obtained in this trial.

The results of all the trials since 1954 are shown in the following table. Net yields, after deduction of the seed used for sowing, are given in lb. per acre of paddy.

Seed rate	*Year*				
lb. per acre	*1954*	*1955*	*1956*	*1957*	*1958*
40 ..	367				
60 ..		1,799		871	
75 ..					1,070
80 ..	443	1,903	657	990	
100 ..		1,935	712	955	
120 ..			603		
150 ..					965
160 ..	345				

It is concluded that the optimum seed rate for machine-drilled rice, hand-weeded and grown in dry to semi-swamp conditions, is 80 to 100 lb. per acre.

4. Rice. Level of Phosphatic Fertilizer (Kizimbani)

Previous trials have shown significant positive responses to medium dressings of superphosphate. This trial, which repeats an identical trial undertaken in 1957, was designed to ascertain the upper limit of response in the presence and absence of added nitrogen. The experiment was carried out in the dry, raised valley of Nguruweni.

Design: Simple factorial (12 combinations).

Treatments: Phosphate: Nil, 3, 5 and 7 cwt./acre single superphosphate.
Nitrogen: Nil, 2 and 4 cwt./acre sulphate of ammonia.

Results: lb. paddy per acre.

	P0	*P3*	*P5*	*P7*	*Average*
N0	1,237	1,725	1,612	1,800	1,593
N2	1,200	1,950	1,587	1,912	1,662
N4	825	1,875	1,725	1,650	1,518
Average	1,087	1,850	1,641	1,787	1,591

Difference required for significance (P=0.01) = 355.

All applications of phosphate gave significantly higher yields than no phosphate. There was no significant difference between the three levels of applied phosphate. Applications of nitrogen were not significant nor was there a significant interaction between nitrogen and phosphate.

Analysing the results as a single randomised block experiment the following significant differences emerge:

(i) N4P0 is significantly less at the 1% point, than all treatments except N0P0 and N2P0.

(ii) N4P0 is very nearly significantly less than N0P0 at the 5% point.

(iii) N2P0 is significantly less than N2P3, N2P7, N4P3 (at the 1% point) and N0P3, N0P7, N4P5, N4P7 (at the 5% point).

(iv) N0P0 is significantly less than N2P3, N2P7, N4P3 (at the 1% point) and N0P3, N0P7, N4P5 (at the 5% point).

(v) N2P3 shows the highest yield, but is not significantly greater than any of the other treatments which include P.

Conclusions.

(i) The addition of phosphate is essential but 3 cwt. per acre of single superphosphate is a sufficient quantity. (In the 1957 trial, yields increased up to 5 cwt./acre.)

(ii) The response to phosphate is not significantly affected by the level of applied nitrogen or by its absence. (In 1957 it was observed that high levels of P require high levels of N and *vice versa*.)

(iii) In the presence of phosphate, there was no significant response to nitrogen and certainly not more than 2 cwt./acre of sulphate of ammonia should be used. (In 1957 there was stronger, though not significant, evidence for using 2 cwt./acre.)

(iv) In the absence of phosphate, increases in nitrogen may reduce yields. (This tendency was observed with applications greater than 2 cwt. in 1957.)

5. Rice. Treatment of Land between Successive Crops (Kizimbani)

Experiments were established in 1954 at two rice areas of Kizimbani to ascertain the most advantageous treatment of land between rice crops when cultivation (other than weeding) is mechanical. In 1955 significant increases in the rice crops were obtained at Kinuni Moshi (the wetter area) with ridging' composting and clean cultivation of the intervening break. In 1956 there were no significant responses, but in 1957, at Kinuni Moshi, sweet potatoes with compost gave a highly significant increase, while sweet potatoes and groundnuts on ridges, without compost, gave a significant increase. The yields given by the two treatments on the flat were not significantly greater than that of the control. At Nguruweni no significant responses were observed in any year, but sweet potatoes without compost had an apparently adverse effect in 1956 and 1957.

Design: 6×6 Latin square.

Treatments: As below; manure:— 20 tons/acre farmyard manure.

Results:

Treatment	*Yield: lb. paddy per acre* *K. Moshi*	*Nguruweni*
1. Sweet potatoes on ridges	1,483 ..	1,016
2. Sweet potatoes on ridges, manured	1,891 ..	800
3. Groundnuts on ridges	1,391 ..	917
4. Gram on the flat	1,408 ..	991
5. Clean cultivated	1,333 ..	1,016
6. Control, land untouched	1,241 ..	817
Differences required for significance:		
at P = 0.01	1,011 ..	335
at P = 0.05	743 ..	249

There were no significant differences at either centre. At Kinuni Moshi the yields follow the same order as those of previous years and tend to confirm the value of manuring and ridging. At Nguruweni, the yields of treatments (1) and (5) approached significance over those of (2) and (6). The favourable effect of sweet potatoes (unmanured) is not in accord with the results of previous years.

The results obtained since 1955 indicate that in the wetter soil of Kinuni Moshi, catch-cropping, particularly with the use of manure, will result in an increased rice crop. In the drier area of Nguruweni ridging and the use of manure may reduce the crop, but catch-cropping on the flat and clean cultivation may be beneficial. The adverse effect of manure is in producing plants with a more luxuriant growth and with greater water requirements and such plants suffer more severely during a subsequent drought period, particularly if this should occur at flowering time.

6. Maize. Plant Population and Fertility Level (Kizimbani)

In 1956 it was shown that a maize population of 4 plants per square yard, planted at 3′×18″ with 2 plants per site, gave a significantly greater yield than maize planted at 3′×18″ with one plant per site, that is 2 plants per square yard. The present trial was designed to investigate still higher plant populations. At the same time the inter-related effect of fertility level was sought.

Design: Randomized blocks (5 replications), with split plots.

Treatments: Main plots 3′×18″ thinned to 2 plants.
3′× 9″ thinned to 2 plants.
3′× 9″ thinned to 1 plant.
3′× 6″ thinned to 2 plants.
3′× 6″ thinned to 1 plant.

Sub-plots No fertilizers.
Fertilizer and manure, viz. 1 cwt. sulphate of ammonia, 2 cwt. single superphosphate and 10 tons farmyard manure per acre.

Rainfall was adequate throughout the trial.

Results:

Spacing	*Plants per sq. yard*	*Yield: lb./acre dried grain*		
		Manured	*Unmanured*	*Average*
3′ × 18″ (2) ..	4	2,960	840	1,900
3′ × 9″ (1) ..	4	2,580	470	1,525
3′ × 6″ (1) ..	6	2,540	370	1,450
3′ × 9″ (2) ..	8	2,240	300	1,270
3′ × 6″ (2) ..	12	2,300	380	1,340
Average		2,524	472	1,498

Differences required for significance:

Main plots:	at P = 0.01	503.
	at P = 0.05	365
Sub-plots:	at P = 0.01	674

Manuring gave a highly significant increase of 2,052 lb. of maize grain per acre. The difference between the yields of the 3′ × 18″ spacing with 2 plants per site and the 3′ × 6″ spacing with 2 plants per site was significant at the 1 per cent. point. The difference between the first spacing and all others was significant at the 5 per cent. point. There was no significant interaction between manuring and spacing. It is concluded that maize should not be planted closer than 3′ × 18″, leaving 2 plants per site, whether or not it is manured.

7. Maize. Plant Population and Residual Fertility (Kizimbani)

This trial was designed to investigate further the effect of spacing, as it applies to short-term maize planted in the second rains. At the same time the residual effect of fertilizers applied to a maize crop grown in the previous rains was investigated. The trial was carried out on the experimental site used in trial 6, described above. The maize was planted on 23rd September and rainfall was normal for the season.

Design: Randomized blocks (5 replications), with split plots.

Treatments: Main plots: 3′ × 18″ thinned to 2 plants.
3′ × 9″ thinned to 2 plants.
3′ × 9″ thinned to 1 plant.
3′ × 6″ thinned to 2 plants.
3′ × 6″ thinned to 1 plant.

Sub-plots: No fertilizers.
Residual effect of 1 cwt. sulphate of ammonia, 2 cwt. single superphosphate and 10 tons farmyard manure per acre applied to a maize crop six months previously.

Results:

Spacing	*Plants per sq. yard*	*Yield: lb./acre dried grain*		
		Manured	*Unmanured*	*Average*
3′ × 18″ (2)	4	1,300	560	930
3′ × 9″ (1)	4	1,250	290	770
3′ × 6″ (1)	6	1,070	180	625
3′ × 9″ (2)	8	950	220	585
3′ × 6″ (2)	12	1,060	120	590
Average		1,126	274	700

Differences required for significance:

Main plots:	at P = 0.01	319.
	at P = 0.05	231.
Sub-plots:	at P = 0.01	444.

Manuring gave a highly significant increase of 852 lb. of grain per acre for all spacings. The widest spacing gave a highly significant increase over the two spacings with the greatest populations and a significant increase over the spacing with six plants per square yard. There was no significant interaction between manuring and spacing. The results obtained in this trial were exactly the same as those obtained in the preceding trial. It may be concluded that in the range of plant populations used, the total plant population rather than the spacing within the row is of primary importance but that in a given population, a wider spacing between planting sites, using two plants per site, is preferable. This applies whether or not the crop is manured. The results suggest further experimentation at lower plant populations, when an interaction with manuring may make itself apparent.

8. Maize. Application of Nitrogen Fertilizer (Kizimbani)

It is customary in the manuring of cereals to apply a proportion if not the whole of the nitrogen fertilizer as a top dressing. In 1956, sulphate of ammonia applied to the seedbed increased the yield of maize by 100 lb. per acre compared with top dressing. The present trial was designed to investigate the problem further.

Design: Randomized blocks (5 replications.)

Treatments: Applications of sulphate of ammonia.

(A) 1 cwt./acre, prior to ridging.
(B) 1 cwt./acre, as a top dressing.
(C) Half cwt./acre, prior to ridging and half cwt./acre as a top dressing.
(D) 1 cwt./acre prior to ridging and 1 cwt./acre as a top dressing.

An overall dressing of single superphosphate at 2 cwt./acre was given to all plots on 12th March prior to ridging. The early dressings of sulphate of ammonia were made on the same day. The maize—local white maize— was sown on the made ridges on 12th March. The top dressings were given on 8th April. Rainfall was adequate.

Results: A = 1,510 lb. dry grain per acre.
B = 1,360 lb. ,, ,,
C = 1,390 lb. ,, ,,
D = 1,650 lb. ,, ,,

Difference required for significance (P = 0.05) = 361.

Although no significant difference was obtained, the application of nitrogen fertilizer immediately before sowing once again gave an increased yield (150 lb.) as compared with the later application. There would at least appear to be no clear advantage in top dressing, a method which is less convenient than application to the seed bed. Application of greater quantities of sulphate of ammonia prior to sowing merits further investigation.

9. Maize. Placement of Phosphate Fertilizer (Kizimbani)

In 1956 there was a strong indication that an overall dressing of superphosphate gave higher yields than placement of the fertilizer. The present trial was laid down to confirm or reject this indication.

Design: Randomized blocks (5 replications).

Treatments: Single superphosphate at 2 cwt./acre.

A Dressed overall prior to ridging.
B Lined at the base of the ridges prior to ridging.
C Placed at the planting sites.
D No phosphate fertilizer.

All plots received a top dressing of 1 cwt./acre sulphate of ammonia. The superphosphate was applied and the maize sown on 12th March.

Variety: Local white maize.

Results: A = 1,100 lb. dry grain per acre.
B = 1,120 lb. ,, ,,
C = 1,030 lb. ,, ,,
D = 110 lb. ,, ,,

Differences required for significance (P = 0.01) = 594.
(P = 0.05) = 420.

The effect of superphosphate was highly significant but there were no significant differences between methods of application. In view of the two year's results, and the convenience of applying an overall dressing prior to ridging, this method is to be preferred.

10. Maize. Variety Trial for Rust Resistance (Makunduchi)

In the coral areas of Makunduchi, in the south of Zanzibar island, maize is a major food crop. Rainfall during the normal planting season is unreliable—it may be very heavy or very light—but the rains are usually of short duration. A short-term yellow maize is generally grown. This has suffered severely from *Puccinia polysora* in the past. The present trail—a 5 × 5 Latin square—was designed to test three varieties from Tanganyika which had been bred to contain gene 1 giving resistance to strain 1 of the rust, viz. Tanag No. 1 yellow flint, Tanag No. 1 white flint, and Tanag No. 2 white dent. White Muratha, commonly grown in the wetter areas of Zanzibar, was also included.

All plots were given overall dressings of 2 cwt. muriate of potash and 1 cwt. sulphate of ammonia per acre prior to planting (the soil is a potash-deficient red soil derived from coral). All varieties germinated well but two weeks' subsequent dry weather necessitated gapping and watering. The Tanag varieties were more severely affected by the dry weather than the local yellow maize. Full stands were not attained and at harvest the number of plants per plot varied from 123 to 44.

Puccinia polysora was assessed on the scale described by Storey *et al*, *Emp. J. Expt. Agric.* 1958, 26, 4. No signs of possible rust symptoms were noted until two months after planting, when flowering was commencing. The three Tanag varieties then all showed symptoms which appeared to be classifiable as 01, indicating hypersensitivity. No symptoms were then observable on the local yellow or the white Muratha nor did any develop subsequently. *Puccinia polysora* did not occur generally in the Makunduchi area, during the season, which was somewhat drier than usual. No conclusions may therefore be drawn as to rust resistance, but the relative suitability of the five varieties for Makunduchi conditions is brought out by the other data obtained.

Results:

Variety	*A*	*B*	*C*	*D*	*E*	*F*
Local yellow	88	486	1.06	2.3	888	2,422
White Muratha ..	102-108	323	.92	2.4	528	1,952
Tanag 1 yellow ..	102-108	463	.73	1.5	372	2,016
Tanag 1 white	102-108	353	.87	2.4	552	1,571
Tanag 2 white	102-108	335	.90	2.3	516	1,773

Reference:

A = Number of days to maturity.
B = Number of plants.
C = Cobs per plant.
D = Weight of grain per cob, ounces.
E = Weight of grain per acre, lb.
F = Number of grains in 1 lb.

It is clear that under the dry conditions experienced, in the absence of rust attack, the local yellow maize is superior to all the others. Survival and cob formation was better, with the result that, although the grains are smaller, total yield per acre was markedly greater. It was particularly disappointing that the Tanag yellow, derived from Afro 29 × Yellow Coast, did so poorly.

11. Sweet Potatoes. NPK and FYM (Kizimbani)

Results from fertilizer trials at Kizimbani in the past have been unclear. In 1957 urea and sulphate of ammonia produced apparent reductions in yield. In other trials phosphate had given significant responses but there was no interaction between N and P. Response to farmyard manure had been variable. The present two trials, on different sites at Kizimbani, explored the problem further.

Variety: B 44.

Design: 2^4 factorial, two replications.

Treatments: N = 1 cwt./acre sulphate of ammonia.
P = 2 cwt./acre single superphosphate.
K = 1 cwt./acre muriate of potash.
D = 5 tons/acre farmyard manure.

The fertilizers were broadcast over the plots prior to ridging while the dung was lined at the base of the ridges, before ridging.

Results:

Due to:	*Effects, cwt./acre* *Kipange*	*K. Moshi*
N	7.4	–0.7
P	21.5**	–3.4
Interaction N × P	13.9×	3.1
K	–4.7	4.2
Interaction N × K	5.5	0.9
,, P × K	–9.3	2.5
D	35.5**	7.9**
Interaction N × D	–1.2	1.6
,, P × D	–18.2**	–4.1
,, K × D	3.2	2.5
Mean yield	70.6	13.9

** = significant when P = 0.01.
× = significant when P = 0,05.

There was a highly significant response to farmyard manure at both centres, at one of which the average level of production was good while at the other it was very poor. At Kipange, where farmyard manure was applied alone every lb. of manure produced over half a lb. of potatoes. The highly significant response to phosphate was not unexpected at Kipange. The highly significant negative response to the phosphate and dung interaction is interesting but unexplained. It was present, though not significant, at Kinuni Moshi, and has been observed in earlier experiments.

It seems probable that a response of sweet potatoes to fertilizers of all kinds would be influenced very greatly by the weather, for it is known that the plant's response in vine or tuber production is strongly influenced by the time of planting in relation to the rains. In this instance fertilizers were applied and the crop planted in mid-June and harvested in mid-November, the same dates being ovserved at both centres. Rainfall was adequate. Kipange has a red sandy loam while Kinuni Moshi consists of grey swamp soil. The two trials were no more than half a mile apart and experienced the same weather.

12. Sweet Potatoes. Farmyard Manure (Kizimbani)

The effect of farmyard manure on sweet potatoes is shown in the yields of the crops grown in the fallow period of experiment 5 above.

Yields of fresh roots in cwt. per acre:

	Kinuni Moshi	*Nguruweni*
With farmyard manure at 10 tons/acre	75.1	12.4
Without farmyard manure	22.3	10.3

Poor yields at Nguruweni were due to a curtailed growing period between the two rice crops.

13. Sweet Potatoes. Spacing of Ridges (Kizimbani)

A previous trial had shown that with a spacing of 2′ between planting sites along the ridges, a distance of 2′ between ridges was too small; spacings of 3′ and 5′ gave the highest yields, which closely approached significance, while the 4′ spacing gave an intermediate figure.

Variety: B 44.

Design: 4 × 4 Latin square.

Treatments: Ridges at 3′, 4′, 5′ and 6′ apart.

Results: Yield of fresh roots:

3′ ridges — 7.41 tons per acre.
4′ ,, — 5.95 ,, ,,
5′ ,, — 6.31 ,, ,,
6′ ,, — 5.59 ,, ,,

Differences required for significance:

at P = 0.01 1.49.
at P = 0.05 0.99.

The greater yield of the 3′ ridges was highly significant in comparison with that of the 6′ ridges and significant in comparison with those of the other two spacings. It is concluded that the 3′ spacing of the ridges is correct under Kizimbani conditions. The experiment was planted on 4th May and harvested at the beginning of October. The site had been a stock paddock for many years previously.

14. Yams. Fertilizer Trial (Makunduchi)

Compost has been proved to produce very considerablei ncreases in yield of yams grown on *kinongo* soil derived from coral. It was desired to see whether fertilizers could have the same effect.

Variety: Lisbon bottleneck.

Design: Randomized blocks, 9 treatments, 4 replications.

Treatments: All combinations of the two fertilizers:
Sulphate of ammonia at 0, 1 and 2 cwt./acre.
Muriate of potash at 0, 1 and 2 cwt./acre.

Both fertilizers were applied two to three days before planting on 19th December. The planting date was later than was desirable. The crop was harvested in early October. Vines had dried in the plots devoid of potash by the end of July, and in most other plots by the end of August.

Results: Yields of fresh tubers in tons per acre.

		Levels of nitrogen			
		NO	*N1*	*N2*	*Means*
Levels	KO	2.2	1.6	2.3	2.0
of	K1	4.1	5.4	4.1	4.5
Potash	K2	3.9	4.4	3.8	4.0
Means		3.4	3.8	3.4	

Differences required for significance at P = 0.05:
For individual treatments 2.4
For means 1.4

The application of potash has given a highly significant increase in yield but there was no significant response to nitrogen or to the interaction. Potash was clearly deficient, but in the rather dry growing conditions of this particular season the higher levels of fertilizer were not required. The maximum increase, from 2.2 tons to 5.4 tons was comparable to what might have been expected from the use of compost.

15. Yams. Fertilizers, Compost and Coir Dust (Mkwajuni)

Large increases in yield of yams through the use of compost have been demonstrated regularly on the *kinongo* soil of Mkwajuni. The present trial was a preliminary investigation of the value of coir dust and fertilizers.

Varieties: Lisbon bottleneck, Mondo and Joka.

Design: Non-replicated.

Treatments: A. Compost at the rate of one 4-gallon tin per planting site, mixed with the soil in the hole.

B. Coir fibre dust at the same rate and applied in the same manner.

C. Coir fibre dust applied as above, with a later top dressing of sulphate of ammonia at a rate of about ½ oz. per plant or 1 cwt. per acre applied 4 months after planting.

D. A composite NPK dressing applied to the planting site at planting, at an approximate rate of 1 cwt. sulphate of ammonia, 1 cwt. single superphosphate and 1 cwt. muriate of potash per acre, with 1 cwt. per acre sulphate of ammonia added 4 months later.

E. No compost, coir fibre or fertilizer.

The yams were planted in December and harvested in September. It was very noticeable that the compost plants produced the most rapid and luxuriant growth and retained their foliage longest. The coir dust with the top dressing of sulphate of ammonia was next best in these respects.

Results: Yields of fresh root in tons per acre:

	Bottleneck	*Mondo*	*Joka*	*Average*
Compost	9.5	7.3	8.0	8.3
Coir + N	9.9	7.1	6.7	7.9
N.P.K.	3.9	5.6	8.4	6.0
Coir	2.7	3.5	1.9	2.7
Control	1.2	1.3	0.7	1.1

The high yield given by the coir dust with the top dressing, compared with the coir dust alone and with the control, is most interesting, particularly since the top dressing was applied in April, four months after planting. It poses the questions, firstly, what would be the effect if the nitrogen is applied at the same time as the coir dust, and secondly, what would be the effect if the nitrogen of the NPK dressing is applied in April instead of at planting.

16. Cassava. Variety Trials

The cassavas tested in these trials were bred at Amani by the East African Agriculture and Forestry Research Organisation.

A. Makunduchi (Kinongo soil):

Seven varieties out of eleven received from Amani in 1953 and tested at Kizimbani where they did not do very well, were retained for testing in other localities, in comparison with the local Msitu.

Design: Randomized blocks.

Operations: Planted May, 1957, harvested May, 1958.

Results:

Variety	*Yield tons/acre*	*lb./plant*	*Percentage infection*	*Raw Palatability*
4641/2 . .	10.1 ..	8.7 ..	50 ..	Sweet.
4723A/26 . .	5.7 ..	5.0 ..	75 ..	Sweet.
4760/37 . .	5.5 ..	4.8 ..	50 ..	Bitter.
4763/16 . .	5.3 ..	4.6 ..	trace ..	Sweet, fibrous.
46301/15 . .	4.6 ..	4.0 ..	25 ..	Sweet, dry.
4759/23 . .	4.6 ..	4.0 ..	trace ..	Bitter, fibrous.
Msitu . .	3.4 ..	3.0 ..	100 ..	Sweet.
4751/5 . .	3.2 ..	2.7 ..	trace ..	Slightly bitter.

The differences in yield between the first listed variety and all the others were highly significant. Those between the next two varieties and the last two were also highly significant, as was that between 4763/16 and 4751/5. The yield of 4763/16 was significantly greater than that of Msitu.

The six highest yielding varieties are being retained for a further trial.

B. Kizimbani (Changa soil)

Five varieties received from Amani in 1956 and first tested in a variety trial at Kizimbani in 1957.

Design: Randomized blocks.

Operations: Planted November, 1957, harvested December, 1958

Results:

Variety	*Yields, tons per acre* 1958	1957	Average	Palatability
5317/21	6.41	5.54	5.98	Sweet.
53121/22	6.31	4.62	5.47	Sweet.
5315/39	6.17	5.75	5.96	Bitter.
5342/1	5.31	4.60	4.96	Sweet.
5318/34	4.67	4.67	4.67	Sweet.

Differences required for significance (1958):

at P	= 0.01	1.28.
at P	= 0.05	0.91.

The yields of the first three varieties are highly significantly greater than that of the last, while the first two varieties gave significantly more than 5342/1. The order of yielding in 1957 was substantially the same except for 5315/39 which was the highest yielder in that year. It is being discarded, however, because of its bitterness, as are the last two on grounds of yield.

17. Pineapples. Mulching (Kizimbani)

In a simple unrandomized comparison two one-eighth acre blocks of pineapples were mulched with coir fibre dust and two received no mulch. The pineapples were planted in 1954 and the mulch was applied from the start. It was applied to a depth of about 5 inches and was renewed about once a year as it broke down. Both treatments were kept as free of weeds as possible. It was noteworthy that the mulch greatly reduced the need for weeding, though after two years weeds were growing through the mulch. Harvesting began in 1956 and continued in 1957 and 1958, when most of the plants became exhausted and the trial ceased.

Results: Yields per acre:—

Period	*Treatment*	*Number of fruits*	*Weight lb.*	*Weight per fruit: lb.*
1956	Coir dust	648	3,838	5.92
	Control	1,172	5,096	4.34
1957	Coir dust	1,384	6,665	4.81
	Control	932	3,223	3.45
1958	Coir dust	1,180	5,792	4.90
	Control	732	1,304	1.78
Total	Coir dust	3,212	16,295	5.07
	Control	2,836	9,623	3.39

The mulched plants grew to a greater size and were greener in appearance. They were slower to come into fruit but over the whole period produced many more pines which were of a greater average size than those from the un-mulched plots.

Another trial, planted in 1956, gave its first crop in 1958. In this case, the crop harvested from April to December showed that the mulched plants produced a greater number of fruit, and fruit of a larger average size.

18. Derris. Periods to Harvest (Kizimbani)

In a trial, concluded in 1957, it was shown that when derris was harvested at 12, 18 and 24 months, the last gave the highest yields, closely followed by harvesting at 18 months. The differences between these yields and that at 12 months were highly significant, the total weight averaging 965 lb. compared with 297 lb. Of three spacings, 2′ gave significantly greater yields than 3′ or 4′.

The trial was repeated by planting in April, 1956, using the same spacings, and comparing harvesting at 18, 24 and 30 months.

Design: Randomized blocks with split plots.

Treatments:

Main plots: Harvesting at 18 months, 24 months and 30 months.
Sub-plots: Spacing at 2 ft., 3 ft. and 4 ft. along ridges 5 ft. apart.

Results: Yields in lb./acre of dried roots.

	2 ft.	3 ft.	4 ft.	*Average*
Harvested at 18 months ..	1,028	806	887	907
,, ,, 24 ,, ..	1,210	1,008	866	1,028
,, ,, 30 ,, ..	1,391	1,149	1,048	1,196
Average:	1,209	987	933	1,043

Differences required for significance:

For time of harvest:	at P = 0.01	431
	at P = 0.05	303
For spacing:	at P = 0.01	171
	at P = 0.05	127

Differences due to time of harvest closely approached significance. There was a highly significant difference due to spacing. In conclusion, it is clear that planting at 2 ft. intervals is to be recommended and that harvesting date within the period from 18 months to 30 months will depend on the weight that is given to the particular factors in each case. The greatest increment in yield occurs in the first 18 months and if a maximum annual return per acre is required the crop will be harvested as soon as convenient after 18 months. If it is desired to obtain maximum returns for the capital outlay, excluding the value of the land, harvesting may be delayed until 30 months. But it has been observed in other trials that rotenone content decreases with age, which affects the financial return. It is concluded that a growth period of about 21 months, to coincide with the desired planting and harvesting weather, is preferable.

19. Microplot Trials with Coir Dust Ash

The object of the trials was to test the value of the ash as a potash fertilizer. The ash contained 11.5 per cent. water soluble potassium. Muriate of potash was used as a comparison.

The experiments were conducted in November/December, 1958, at Ndijani on shallow *kinongo* soil. The crops were maize and cowpeas, harvested after 40 days and weighed green.

Design: 2^3 factorial, 4 replications.

Treatments: Coir dust ash = 100 lbs. K/acre.
Muriate of potash = 100 lbs. K/acre.
Sulphate of ammonia = 100 lbs./acre.

Results: Maize N + ve at P = .01.
Cowpeas N + ve at P = .05.

The responses to N were expected. The lack of response to K was unexpected and defeated the purpose of the experiments.

B. FIELD EXPERIMENTS—TREE CROPS.

1. Coffee. Fertilizers and Mulch (Kizimbani)

This experiment with *liberica* coffee was planted in 1950 and the treatments were first applied in 1954. The 1958 crop was the fourth full crop to be harvested. The results from the earlier harvests are included here for comparison.

Design: 2^4 factorial, two replications.

Treatments: N = 1½ lb. sulphate of ammonia per tree per annum.
P = 1½ lb. single superphosphate per tree per annum.
K = ¾ lb. muriate of potash per tree per annum, increased to 1½ lb. in the second rains of 1958.
M = deep mulching with banana trash.

Results:

Due to		*Effect, cwt./acre fresh cherry*			
		1955	*1956*	*1957*	*1958*
	N	4.4	2.0	4.2	7.8
	P	—5.9	—2.7	—4.2	5.4
Interaction	N × P	2.2	—1.4	0.4	3.5
	K	9.1	—0.3	5.1	4.3
Interaction	N × K	—3.2	5.1	0.8	3.9
,,	P × K	—2.6	—1.5	—1.1	4.6
	M	12.7*	10.1**	26.9**	31.4**
Interaction	N × M	—7.0	—1.1	—4.2	—5.9
,,	P × M	4.2	—0.4	7.3	11.0
,,	K × M	7.4	0.1	2.8	5.0
Average yield		29.3	14.3	27.5	33.0

** = significant when P = 0.01.

* = significant when P = 0.05.

The response to mulching was highly significant but there were no oth significant responses.

Mulching continues to give large increases in yield and the amount of the increase rises as the bearing potential of the trees increases. In 1958, the plots with mulch alone yielded almost four times as much as the plots with no mulch or fertilizer. Other yield comparisons are shown in the following table.

Treatment	*Yield, cwt./acre fresh cherry*
Control	12.80
N	26.96
P	4.71
K	11.79
M	50.22
NPK ..	14.83
NPKM	77.85

2. Cloves. Fruiting Hormone (Kizimbani)

A preliminary non-randomized test to discover whether cloves would show any response to the application of hormones. Alpha-naphthalene acetic acid was sprayed on trees of about 12 years of age at a rate of 3 ccs. per gallon of water, thoroughly wetting the leaf surfaces. The first spraying was done in December, five adjacent trees within a row being treated and five trees in the adjacent row being left as a control. At each subsequent spraying—occurring at fortnightly or monthly intervals—five trees in the next following row were treated and a control again left. But initials appeared about April and the crop was harvested in December.

Results: Yields in lb. of green cloves.

Date of spraying	*Yield of five treated trees*	*Yield of five untreated trees*
20.12.57	18.6	5.3
3.1.58	13.2	9.4
16.1.58	21.7	8.7
30.1.58	17.2	4.8
28.2.58	8.6	23.0
31.3.58	4.4	5.0
30.4.58	26.8	5.8
30.5.58	12.9	20.1
Totals	123.4	82.1

The apparent effects of the spraying during the months of December and January are considerable, while the later sprayings have had no effect, as shown below:—

	Treated lb.	*Control lb.*
Period 20.12.57 to 30.1.58 ..	70.7	28.1
Period 28.2.58 to 30.5.58 ..	52.8	54.0

3. Limes. Seedlings V. Budded Plants and Fertilizers

Site: On *changa* soil at Dole, near Kizimbani.

Plants: Planted in 1952. The budded plants are on rough lemon stocks.

Design: 6 randomized blocks with split plots.
9 trees per sub-plot at 15′ × 15′.

Treatments: Main: Budded trees.
Seedling trees.

Subsidiary: No fertilizer.
Fertilizer at low level.
Fertilizer at high level.

The fertilizer used is a mixture of sulphate of ammonia, single superphosphate and muriate of potash in the proportions 3 : 3 : 1 by weight. From 1952 to 1956 low level was ½ lb. per tree and high level 1 lb. per tree, each divided equally between two applications, before the main and second rains. Since 1957, the rates have been doubled.

Results:

	lb. fruit per acre			
	1955	*1956*	*1957*	*1958*
Budded trees no fertilizer	804	9,603	8,624	2,642
,, ,, low fertilizer	980	9,162	9,884	3,920
,, ,, high fertilizer	1,303	9,707	11,535	3,852
Average of budded trees	1,029	9,493	10,014	3,471
Seedling trees, no fertilizer	32	1,066	1,994	569
,, ,, low fertilizer	14	822	1,765	554
,, ,, high fertilizer ..	36	959	2,331	533
Average of seedling trees .. .	28	949	2,030	552

The least significant difference (at P = 0.05) for seedlings v. budded limes is 2875. Thus budded limes yielded a significantly greater weight of fruit than seedling trees. Fertilizer treatments, however, showed no significant effect on yield of either type of tree. This result is in conformity with those of 1956 and 1957.

If the experiment is analysed on the basis of the number of fruits instead of their weight, the difference between the yields of budded and seedling trees just fails to reach significance. This is attributable to the fact that the average weight of fruit from the budded trees was slightly greater, thus:—

budded limes: 14.22 lb. per 100 fruits.
seedling limes: 13.18 lb. ,, ,,

This difference was not statistically significant.

C. YIELD RECORDS

1. Cocoa.

At Kinuni Moshi (Kizimbani) there are a few *forastero* cocoa trees of varied type which were planted about 1900. These trees were neglected for a long period but in recent years have been maintained in clean condition but without insect control. The trees are growing in the open. *Helopeltis* is present.

Yields of the five best trees during 1958 and in previous years were as follows:—(All weights are in lb.)

Tree No.	*No. of pods*	*Wt. of pods*	*Wt. of wet beans*	*Dry cocoa equivalent at 40 per cent.* 1958	1957	1956	1955	*Average*
2	71	111.5	18.12	7.25	15.60	26.00	28.72	19.39
4	76	101.0	16.56	6.62	9.70	23.30	18.76	14.60
7	63	75.5	14.25	5.70	4.16	14.00	12.52	9.10
9	47	41.0	10.00	4.00	5.20	8.90	13.84	7.99
15	46	44.8	9.50	3.80	3.76	12.20	15.56	8.83
Average	61	74.8	13.69	5.47	7.68	16.88	17.88	11.98

The 1958 harvest was later than usual and a large proportion was picked in January, 1959; this will be included in the 1959 records.

2. Citrus

(1) *Budded oranges.* (Kizimbani) Planted 1936.

Yield in numbers of fruit per tree; 1942–1958:

1942	62	*1946*	191	*1951*	177	*1955*	166
1943	506	*1947*	176	*1952*	243	*1956*	448
1944	52	*1948*	287	*1953*	94	*1957*	330
1945	261	*1949*	*342*	*1954*	370	*1958*	316

Note: 1950 no records.

(2) *Limes, budded and seedling.* (Dole) 8 acres planted 1952.

Harvests, 1956 to 1958:

	1956	*1957*	*1958*
Number of fruits per acre	26,748	52,144	19,727
Weight of fruits, lb. per acre	4,037	6,764	2,764
Number of fruits per tree	133.7	260.7	98.6
Weight of fruits, lb. per tree	20.2	33.6	13.8

Harvest percentage, month by month, 1957 and 1958:

	1957	*1958*		*1957*	*1958*		*1957*	*1958*
Jan.	–	3	May	23	11	Sep.	12	7
Feb.	1	3	June	11	11	Oct.	2	4
Mar.	3	5	July	21	15	Nov.	–	10
Apr.	10	13	Aug.	17	16	Dec.	–	1

(3) *Limes, budded.* (Mkwajuni) 38 trees planted 1952.

Yield of fruit: 1957 44.9 lb. per tree.
1958 17.9 lb. per tree.

Harvest percentage, month by month, 1957 and 1958:

	1957	*1958*		*1957*	*1958*		*1957*	*1958*
Jan.	–	–	May	18	29	Sep.	4	19
Feb.	5	–	June	18	7	Oct.	2	3
Mar.	20	3	July	10	6	Nov.	–	–
Apr.	16	19	Aug.	7	14	Dec.	–	–

3. Ylang Ylang

Kizimbani, block I, planted 1949.

A = Pounds of flowers per tree.
B = Pounds of flowers per acre.
C = Pounds of oil per 100 lb. flowers.
D = Pounds of oil per acre.

Year	*A*	*B*	*C*	*D*
1952 . .	2.85	382	0.59	2.20
1953 . .	2.50	335	–	–
1954 . .	4.56	611	1.61	8.28
1955 . .	4.93	661	1.23	8.12
1956 . .	3.39	454	1.33	6.06
1957 . .	7.18	1,027	1.35	13.86
1958 . .	4.98	667	1.30	8.67
Average . .	4.34	591	1.24	7.86

4. Nutmegs

Four old trees at Kizimbani.

Harvest for 13 months, December, 1957, to December, 1958, inclusive.

	Tree I	*Tree III*	*Tree IV*	*Tree V*	*Average*
Number of nuts	8,320	3,348	3,101	3,444	4,553
Weight of nuts, lb. ..	84.2	32.9	32.6	36.8	46.6
Number of nuts per lb. ..	98.8	101.8	95.1	93.1	97.7

D. STOCK HUSBANDRY

1. Grass Introductions

The following grasses were established at Kizimbani for test: *Digitaria smutsii*, *Cenchrus ciliaris* (ex-Mombasa), *C. ciliaris* (Malopo strain), *C. ciliaris* (selection T 4464), *Chloris gayana* (ex-Nzoia), *C. gayana* (ex-Knoetze), *Ischaemum aristatum* (Batiki blue grass, from Fiji). *Digitaria smutsii* and the Batiki blue grass made promising growth.

2. Natural Grazing: Manurial Trial (Pemba)

During 1957 two fertilizer trials were conducted on the sandy *mtifutifu* soil of north Pemba, the crop being rice. The treatments were sulphate of ammonia at 1 and 2 cwt. per acre, superphosphate at $1\frac{1}{2}$ and 3 cwt. per acre and the burning of coconut leaf trash on the plots according to the local custom. On the completion of the experiment it was desired to see whether residual effects would be apparent in the succeeding natural tumbledown grassland. Three cuts were taken during the year. The total weights of material harvested give strong indications of a positive response to phosphate, especially to the larger dressing. There are also indications of a smaller response to the burning. As was to be expected, there was no response to sulphate of ammonia.

A striking effect was the visible increase in clovers on all those plots which received phosphate. The trial continues.

3. The Milking Herd (Kizimbani)

Breeding and selection for milk production continued, using Boran bull No. 399, his progeny and Zebu bulls of non-Boran blood on local cows and half-cross Boran cows. Herd records are given in Appendix I.

KIZIMBANI STOCK FARM ANNUAL RECORD OF MILK YIELDS (ZEBU BREED)

Year	Average of monthly head of cows in milk and dry	Average annual output of milk per cow	Number of completed lactations	Average milk yield in 305 days lb.	Range in milk yields lb. Minimum	Maximum (305 days)	Average lactation period days	Average calving interval days	Average daily yield per cow in milk lb.
1942 ..	24	975	20	1,078	29 (31 days)	2,637	191	342	4.2
1943 ..	28	792	21	851	3 (31 days)	2,195	160	372	5.4
1944 ..	25	1,341	18	1,112	2 (5 days)	2,455	234	345	5.2
1945 ..	29	1,531	20	1,637	6 (12 days)	4,012	258	353	5.1
1946 ..	47	1,289	36	1,339	6 (12 days)	3,984	217	327	5.9
1947 ..	41	1,637	33	1,682	23 (42 days)	2,976	268	340	6.3
1948 ..	46	1,742	42	1,862	6 (19 days)	4,058	267	337	7.0
1949 ..	62	1,700	52	1,688	19 (17 days)	2,876	242	332	7.0
1950 ..	66	1,696	53	1,805	2 (5 days)	4,150	266	364	7.0
1951 ..	67	2,050	58	1,836	4 (12 days)	3,557	260	364	7.7
1952 ..	59	2,038	55	2,313	13 (16 days)	3,060	304	383	7.8
1953 ..	69	2,077	57	1,819	5 (7 days)	3,603	238	406	8.1
1954 ..	73	2,294	75	2,174	8 (8 days)	4,317	257	375	8.8
1955 ..	70	2,433	72	2,349	4 (14 days)	4,216	263	390	9.0
1956 ..	86	2,021	81	1,987	6 (17 days)	4,257	226	401	9.0
1957 ..	103	2,035	99	2,225	4.3 (22 days)	4,471	256	408	8.9
1958 ..	95	2,028	76	2,134	1 (2 days)	4,012	260	409	7.9